Tonkin & Taylor

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Gisborne District Council
PO Box 747
Gisborne

Attention: Kevin Strongman

Dear Kevin

Wainui Beach Management Strategy - preliminary screening comments

1 Purpose

As a result of the workshop with the Wainui Beach Management Plan Working Group on 7th November 2012 a range of options to manage the coastal erosion along Wainui Beach were identified including:

- Cobble berm revetment
- Dune enhancement
- Rock revetments
- Asset relocation/abandonment
- Emergency geobag protection
- Beach drainage management
- Seawalls
- Beach scraping
- Geobag walls
- Off-shore reefs
- Beach nourishment
- Under-current stabilisers
- Groynes
- Gabion basket seawalls
- Prohibiting new development

A high order assessment was carried out broadly assessing each of these options considering:

- The relative cost,
- Whether the option was fit for purpose,
- If already proven in the high energy open coast environment,
- The likelihood and risk associated with statutory approvals, and;
- Reasonable design life.

Tonkin & Taylor Ltd - Environmental and Engineering Consultants, 105 Carlton Gore Rd, Newmarket, Auckland, New Zealand
PO Box 5271, Wellesley St, Auckland 1141, Ph: 64-9-355 6000, Fax: 64-9-307 0265, Email: auck@tonkin.co.nz, Website: www.tonkin.co.nz

The results of the high order assessment indicated that the preferred options included:

- Prohibiting new development within 100 year hazard zone,
- Cobble berm revetment,
- Dune enhancement,
- Emergency geobag protection,
- Asset relocation/abandonment,
- Rock revetments,
- Beach Nourishment.

The remaining options were considered less desirable based on the factors considered although beach scraping could be considered as an emergency management option or as a possible starting point to beach nourishment to reduce the total volume of imported sand. Training walls/groynes at the stream outlets are also not included as an option as they are more associated with stream training and while they may have localised benefits on the adjacent beach, are not applicable along the entire shoreline. The following section provides a short summary of the consideration of each option and the assessment table is included in Appendix A.

2 Consideration of options for high order assessment

2.1 Prohibiting new development in 100 year hazard zone area

If new development is allowed to continue in the hazard zone the relative erosion and inundation hazards will increase as the asset value of development will increase. Prohibiting new development will reduce the increase in asset value. There is likely to be strong opposition for this approach, with the potential of legal appeals, so the cost to implement this option may be high. However, it is an internationally recognised approach to managing coastal hazards but more likely as a medium to longer term option. This approach will be consistent with regard to the New Zealand Coastal Policy Statement (2010) and the RMA.

2.2 Cobble berm revetment

A cobble berm revetment replicates the natural cobble beach that exists under parts of the beach at present and based on historic record, was more significant, particularly towards the southern end of the beach. This option was discussed in the previous report and has been referred to as the Komar cobble berm. The advantage of this system is that it is able to adjust its profile to wave energy and provides a dynamically stable energy dissipater at the top of the beach. It requires suitable sized rock preferably rounded cobbles, but graded quarried rock could be used. The availability of the material may affect costs. Rock size tends to be smaller than required for revetments, which are required to be statically stable and not move. As this option most closely represents the natural system that was originally present, consenting should be more straightforward than as with conventional structural protection options.

2.3 Dune enhancement

Dune enhancement by dune shaping and planting enables the trapping of wind-blown sand to occur within the dynamic beach/dune system and hence reducing sand loss by Aeolian transport. This option has relatively low costs and is a proven approach to improve dune resilience and store sand to respond to storm erosion events. It is consistent with the NZCPS (2010). However, it is less suitable both in areas subject to long-term erosion trends and in areas where there is insufficient sand in the system. It may become less effective over time because of increasing sea levels.

2.4 Emergency geobag protection

Geobag walls are stacked sand filled geotextile containers. Due to their relatively low impermeability they perform similarly to a near vertical impermeable seawall constructed from grouted rock, concrete or timber. They have similar characteristics as conventional seawalls and require adequate foundations, end details for tying in to prevent end effects and a reasonable crest elevation to prevent overtopping scour and toppling failure. They have a shorter design life compared to conventional seawalls due to fabric deterioration due to UV and they are prone to damage and can be vandalised. They are also more suitable in areas of reasonably low wave height (H_s < 1.5 m). However, they may be included as part of an overall management strategy to address localised rip and storm erosion effects. If used in this way they would have a relatively low cost as they would only be applied to those critical erosion areas to provide protection over a relatively short time period which would be appropriate given their relatively short design life. As part of a wider management strategy, the use of short-term structures would be consistent with statutory requirements.

2.5 Asset relocation or abandonment

Asset relocation or abandonment involved the progressive setting back or abandonment of assets where erosion and/or inundation creates a situation where retaining that asset is not sustainable. Asset relocation or abandonment will reduce the value of assets within the hazard zone. There is likely to be strong opposition for this approach, with the potential of legal appeals and potentially issues regarding compensation, so the cost to implement this option may be high therefore it is more likely as a medium to longer term type option. However, it is an internationally recognised approach to managing coastal hazards. This approach is consistent with regard to the New Zealand Coastal Policy Statement (2010) and the RMA.

2.6 Rock revetments

A rock revetment formed from a geotextile filter fabric overlain by a cushioning layer of small rock and protected from wave energy by rock armour placed on a slope is a traditional solution to managing shoreline erosion. They are conventional land protection structures that have been used widely internationally and there are detailed standards for their design. The high porosity provided by the voids between the rock together with the slope provide a form of energy dissipation to wave energy reducing the reflected wave and wave overtopping. Rock armour slopes of around 3(H):1(V) to 4(H):1(V) perform similar to natural beach systems. These can be reasonably expensive depending on the location and quality of suitably sized rock. Structural protection is considered the least preferred approach by the NZCPS (2010) and consent approval can be difficult.

2.7 Beach nourishment

Beach nourishment requires the importing of sand to increase the volume of sand stored on the beach and dunes. The volumes required to provide an erosion buffer would be significant at Wainui and there is no readily available source, so cost for this option would be high. While a proven option, it is likely that storm and rip induced erosion would still occur. This option is suitable with other works, such as dune enhancement and emergency response. However, it would be necessary to have an ongoing supply to provide protection against sea level rise effects. There may be issues with the placed sand having an impact on existing sand bars and there may be consenting risks associated with the source of sand.

2.8 Seawalls

Seawalls are typically steep structures constructed from bound elements, such as concrete, grouted rock, timber and steel. They are typically largely impermeable and need to be well founded as well as having a suitable crest elevation to prevent overtopping induced damage. These structures tend to be reasonably expensive and are inappropriate for natural beach systems, creating significant access issues and changes to natural character. They are more suitable when used to protect cliff-faced shorelines, such as exists along the southern end of Wainui Beach. Structural protection is considered the least preferred approach by the NZCPS (2010) and consent approval can be difficult.

2.9 Beach scraping

Beach scraping is the movement of sand from the intertidal zone to the dune or upper beach by mechanical means. Beach scraping mimics natural beach recovery, but increases the recovery rate compared with natural processes (Carley et al, 2010). While frequently used, there is little practical guidance and information on its physical and ecological effects. Due to the significant shoreline fluctuations observed at Wainui Beach and given the erosion processes are often dominated by rip cell formation and storm effects, beach scraping is unlikely to provide a long-term solution. Scraping could however, be considered as part of an emergency response to stabilise eroding dunes and restore the upper beach provided there was sufficient sand available in the intertidal beach system. There may be concerns raised during the consenting process on effects on marine ecology and this option would typically require comprehensive monitoring.

2.10 Geobag walls

Geobag walls are formed from stacked sand filled geotextile containers. Due to their relatively low impermeability they perform similarly to a near vertical impermeable seawall constructed from grouted rock, concrete or timber. They have similar characteristics as conventional seawalls and require adequate foundations, end details for tying in to prevent end effects and a reasonable crest elevation to prevent overtopping scour and toppling failure. They have a shorter design life compared to conventional seawalls due to fabric deterioration due to UV and they are prone to damage and can be vandalised. They are also more suitable in areas of reasonably low wave height ($H_s < 1.5$ m). Based on recent experience geobag walls can cost in the same order as a conventional rock revetment as the bags have a high unit cost. However, consent authorities have indicated a slight preference with these structures over conventional rock protections structures due to their improved accessibility by the public.

2.11 Submerged offshore reefs

A submerged reef is a structure located offshore designed to induce wave breaking. Coastal protection can occur with increased wave sheltering and by a modification of the wave direction to shore, reducing longshore drift gradients and encouraging sand deposition in the lee of the structure. An advantage of these systems over conventional offshore breakwaters is that they are typically submerged and do not create a visual obstruction.

Some issues identified include their performance as a recreational surf break (Shand, 2011), their ability to protect the adjacent shoreline (Jackson & Corbett, 2007) and concerns for the safety of recreational swimmers landward of the reef. At this location, the potential for amplifying flows/rip cells would also need to be carefully evaluated. Land based works would also be required to manage the dunes as well as beach nourishment by sand transfer. Due to their location in the surf zone construction costs are likely to be high.

There is likely to be strong opinions raised during the consent process both for and against offshore structures. The consenting risk is identified as being significant. The submerged reef approach may provide medium term protection, although additional nearshore nourishment or crest raising of the offshore reefs may be required if sea level rise accelerates as predicted and these may be costly. There is also a risk that the structures may act to focus longshore flows or induce large rip circulation cells, increasing the potential for shoreline erosion and a potential risk of impacts on existing natural surf breaks.

2.12 Beach drainage management

Improvements in beach stability have been attributed to artificially lowering groundwater levels under the beach face. Beach face dewatering by lowering the groundwater table is accomplished by draining water from buried, almost horizontal, filter pipes running parallel to the coastline. The pipes are connected to a collector sump and pumping station further inland.

Early reviews identified that the effectiveness of the concept is yet to be convincingly demonstrated (Leatherman and Turner, 1997). Research that is more recent suggests there is still no consensus on its effectiveness (Bowman, et al, 2007). At this stage dewatering should be regarded as experimental, rather than a proven solution to erosion management (Schwartz(ed), 2005). Field evidence of existing installations indicates an inability of beach dewatering systems to provide adequate protection from storm erosion and the systems themselves are susceptible to storm damage (Engineers Australia, 2012).

No detailed costing information is available for this approach, although a web search indicated that costs are likely to be similar to a large-scale nourishment scheme. However, it is uncertain if it could provide medium to long-term protection. Due to the new technology aspects and the risks to groundwater, we anticipate significant difficulties in progressing through to resource consent.

2.13 Undercurrent stabilisers

Undercurrent stabilisers are a patented ultra-low profile geotextile groynes injected with concrete or sand (CEM, V-3-90, 2006) they have also been proposed as an alternative approach to stabilize beaches. These devices include Holmberg technologies, Longard tubes and other systems.

There is little peer-reviewed published information on this technology and the US Army Corps of Engineers notes that this type of technology does not address all of the key issues raised by them (CEM, 2006). More detailed studies and investigations will be required to improve levels of understanding and knowledge, particularly on the effectiveness and robustness of the design in areas of significant wave energy, such as Wainui Beach

While there are no detailed costings available for these systems, we are aware that working in the surf zone with the energy associated with this coast will be problematic and therefore costly. In addition, dune grading and re-vegetation would also be required.

Structural protection is considered the least preferred approach by the NZCPS (2010). Consenting is likely to be complex due to the new technology and potential adverse effects and risks.

2.14 Groynes

At Wainui the groynes would need to be significant structures extending below the low tide line to sufficiently interrupt alongshore drift and be spaced in the order of 2 to 3 times the groyne length.

The groynes would need to be constructed within a high-energy environment that would create significant construction issues and therefore, high cost. An alternative would be to construct a headland groyne at the southern end to restore the control point previously offered by the reef and headland. To provide some form of measurable control this would need to be a significant structure, at least 200 to 400 m long (several wave lengths) and constructed on the existing reasonably unstable reef that is currently down cutting and eroding.

Groynes do not affect cross-shore transport processes, which is a significant cause of beach erosion at Wainui Beach. Groynes have also been identified as facilitating rip formation, with rips developing adjacent to the groyne. Apart from the potential to increase erosion because of the rip formation, the rips may also affect the surfability of the nearshore bars.

It is anticipated that these structures could have a significant consenting risk with objections likely from beach users, surfers and those wishing to retain a natural environment.

2.15 Status quo

Status quo means carrying on the existing management process along the foreshore. While a relatively low cost approach, with low consenting and approval risk this option does not provide improved erosion protection or address the issues currently experienced along Wainui Beach and runs the risk of ad hoc works and measures occurring.

2.16 Gabion seawall

Gabion seawalls are built by stacking rock-filled wire baskets. They have similar characteristics as conventional seawalls and require adequate foundations, end details for tying in to prevent end effects and a reasonable crest elevation to prevent overtopping scour and toppling failure. The US Army Corps of Engineers http://chl.erdc.usace.army.mil/library/publications/chetn/pdf/cetn-iii-31.pdf identified that gabions may be useful for certain applications in the coastal environment but have limitations, particularly in high energy environments and if not constructed in accordance with suppliers specification.

Due to their relatively short design life in exposed locations they are not considered an appropriate solution as a protection form at Wainui Beach, but as a largely buried backstop wall they may have a place as part of an overall management strategy. Structural protection is considered the least preferred approach by the NZCPS (2010) and consent approval can be difficult.

3 Applicability

This report has been prepared for the benefit of Gisborne District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Richard Reinen-Hamill	Tim Fisher
Senior Coastal Engineer	Project Director

Reviewed by:

Tom Shand

Senior Coastal Engineer

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Appendix A: Preliminary Evaluation Table

Preliminary Option Screening (8 November 2012)

Options	Relative Cost/100 m (H,M,L)	Fit for Purpose (H,M,L)	Proven technology (open coast)	Statutory Appropriateness (H,M,L)	Life (yrs)	Totals Green = 1, brown=3, red=5
Prohibiting to 100 HZ	L	H	Y	H	50	5
Cobble berm revetment	M	H	Y	M	50	9
Dune enhancement	L	H	Y	H	10	9
Emergency Geobag protection	L	M	Y	H	25	9
Asset relocation/abandonment	H	H	Y	H	100	9
Rock Revetments	M	H	Y	L	50	11
Beach nourishment	H	H	Y	M	25	13
Seawalls	M	M	Y	L	50	14
Beach scraping	L	M	U	M	5	15
Geobag walls	M	L	y	L	25	17
Off-shore reefs	H	M	N	L	50	19
Beach drainage management	M	L	N	M	25	19
Under-current stabilisers	M	L	N	M	25	19
Groynes	H	L	N	L	50	21
Status Quo	L	L	N	L	10	21
Gabion baskets	M	L	N	L	10	23